

Benefits of low impact development

To the environment

- Helps maintain natural hydrology.
- Helps maintain stream flows and water levels in wetlands.
- Protects streams and fish and wildlife habitat from high storm flows.
- Reduces pollution in runoff.
- Protects shellfish growing areas and beaches from bacterial contamination.
- Preserves and restores trees and other vegetation.

To developers

- Provides new options for site layout, stormwater facilities and recreation.
- Can help reduce building costs for stormwater management facilities.
- Can help produce more attractive neighborhoods that sell faster and for a premium.
- Can provide more buildable lots by reducing size requirements for stormwater ponds and through incentives such as density bonuses.
- Can reduce stormwater utility fees.



By using a minimal excavation foundation, the builder of this home in Pierce County eliminated the need to extensively excavate and compact soils. | *PIN Foundations, Inc.*

To local governments and communities

- Helps prevent flooding.
- Helps protect streams, salmon and other wildlife, and shellfish growing areas.
- Helps maintain drinking water supplies.
- Can help reduce maintenance costs of stormwater facilities.
- Can help lower costs of streets, curbs, gutters and other infrastructure.
- Increases the appearance and aesthetics of communities.
- Can help increase property resale values.
- Provides new tools for cost-effective urban retrofit.
- Helps reduce contamination of sediments in bays and associated cleanup costs.

LID—Part of the solution

LID should be part of a local, comprehensive stormwater management program that:

- Adopts and uses the Department of Ecology's *2005 Stormwater Management Manual for Western Washington* (or an alternative local manual that is technically equivalent).
- Includes regular inspections of construction sites.
- Ensures maintenance of temporary and permanent facilities.
- Controls the release of pollutants.
- Eliminates illegal dumping and discharges.
- Identifies and ranks existing stormwater problems.
- Educates and involves the public.
- Includes watershed or basin planning.
- Ensures stable, ongoing funding.
- Includes programmatic and environmental monitoring.

LID works with local land use planning under the Growth Management Act. Local governments identify areas to preserve and areas to accommodate growth. Once the growth areas are determined, builders and planners can use LID approaches on building sites to reduce the adverse effects of development.

Need more information?

Visit the Puget Sound Action Team's Web site on low impact development at www.psat.wa.gov/LID. Find news, educational and technical publications, monitoring results, local government regulations and more.

The Action Team is the state's partnership for Puget Sound. Every two years, the Action Team develops a plan and related budget for restoring and protecting the Sound. LID techniques are featured prominently in the *Puget Sound Conservation and Recovery Plan* as a key tool to combat problems from stormwater runoff.

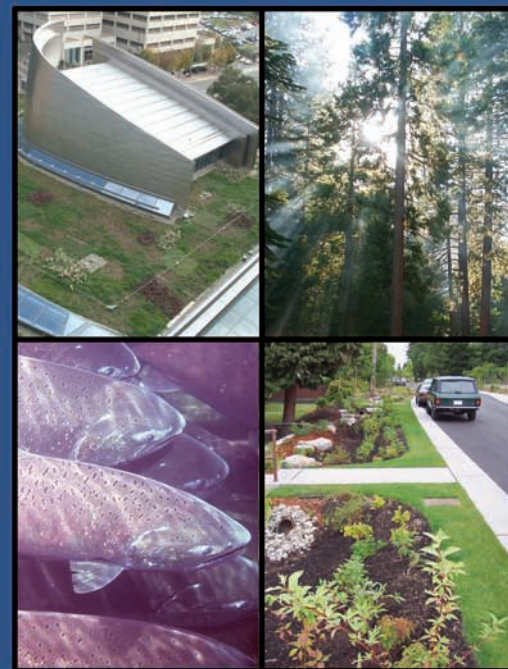
Learn more about the state's two-year plan for Puget Sound at www.psat.wa.gov/2005-2007plan. LID is also included in the *Puget Sound Water Quality Management Plan*—the state and federal governments' long-term plan to protect and recover Puget Sound.

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Low Impact Development

By the year **2025**,
another
1.4 million people
will call Puget Sound
their home.



**How can we
protect
Puget Sound
as we grow?**

PUGET SOUND ACTION TEAM

Office of the Governor, State of Washington

Low Impact Development: Protecting our waters as we grow

By the year 2025, another 1.4 million people will call the Puget Sound region home.* Accommodating this growth while still protecting our natural resources and quality of life presents major challenges.

Growth results in more rooftops, pavement and stormwater runoff. Traditional ways of protecting water resources from stormwater runoff have not proven fully effective, and Puget Sound is threatened by storm flows and pollutants carried by stormwater.

It's time to grow smarter.

Low impact development (LID) can help. LID is a relatively new approach to developing land and managing stormwater runoff. LID mimics what nature has been doing for ages.

In a mature Pacific Northwest forest, very little rainwater runs off the land. Instead, it soaks into the ground, where the soils remove pollutants naturally. The water nourishes trees and plants and recharges streams, wetlands and groundwater. Or, the rainwater evaporates and becomes rainfall again.

Some of the key features of LID include: replanting or protecting existing vegetation; reducing impervious surfaces such as roads, parking lots and rooftops; using bioretention, pervious pavement and other small-scale stormwater controls; and clustering houses and other buildings on a site so stormwater can follow more natural drainage patterns.

LID not only manages stormwater, it makes communities greener and more beautiful. And in many cases, LID projects are less expensive to build and maintain.

* Source: Washington State Office of Financial Management



Permeable pavers at I-5 Park and Ride in Marysville virtually eliminate runoff, remove pollutants, and look good.
| Curtis Hinman

Why do we need low impact development?

Low impact development can help protect our water resources from the harmful effects of stormwater runoff.

Several species of Northwest salmon face the threat of extinction. Numerous shellfish-growing beaches in Puget Sound are too polluted to harvest. Pollution also threatens the health of our urban waters and underwater sediments.

Runoff from stormwater contributes significantly to these problems, and conventional stormwater management practices don't fully protect our waters.

The problem lies in the way land is typically developed.

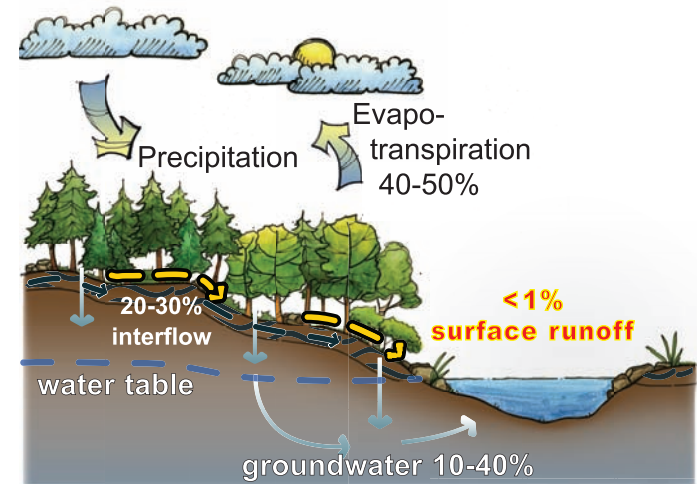
Typical land development involves clearing a site of vegetation, grading it, and then installing roads, parking, utilities, buildings and landscaping. Heavy equipment compacts soils. Detention ponds and vaults are expected to prevent flooding, remove pollutants, slow storm flows, and recharge aquifers and streams.

The before-and-after drawings to the right show how development alters the way water moves throughout a site. Under natural conditions—before development—most of the rainfall seeps through the ground (infiltrates), evaporates or is used by vegetation. Very little becomes surface runoff.

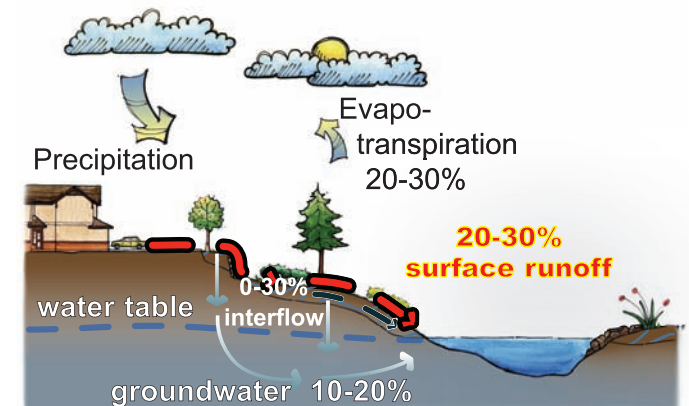
After development, less vegetation and more impervious surfaces cause runoff to increase dramatically (up to 20 to 30 times as much as on undeveloped land). Infiltration also decreases, resulting in less water for streams and wetlands. This has two effects: In wet winter months, increased runoff can damage fish and wildlife habitat and cause flooding. And in dry summer months, streams sometimes lack sufficient flows for fish and seasonal irrigation.

To protect streams from high flows, regulations require developers to install large ponds. Yet ponds don't ensure that streams, wetlands and aquifers are recharged. Ponds don't remove pollutants as effectively as bioretention or native soils. Ponds also take up valuable

BEFORE DEVELOPMENT



AFTER DEVELOPMENT



Before development (top graphic), almost all rainfall is taken up by plants or evaporates (evapo-transpiration) or infiltrates through the ground. After conventional development (lower graphic), surface runoff increases significantly while evapo-transpiration and infiltration decrease. (Interflow refers to water that moves laterally just below the ground surface.) | AHBL, Inc. Planners

land, are difficult to maintain, and can be unattractive. In addition, stormwater released from ponds can be too warm for salmon.

In short, LID represents a new set of tools to improve how we develop land and manage runoff in Puget Sound.

Cover panel photo credits (clockwise from upper left): Seattle City Hall green roof, City of Seattle • forest, stock photo • bioretention swale, Seattle Public Utilities, City of Seattle • chinook salmon, Ernest Keeley.

Key strategies of low impact development

1. Conserve and restore vegetation and soils.

- Retain stretches of native forest cover on undeveloped sites. Restore vegetation on land previously cleared. Vegetation captures, infiltrates and evaporates precipitation.
- Preserve well-draining native soil. Use compost to restore the health of soil disturbed by construction. Healthy soils store and infiltrate stormwater and produce healthy plants that require less watering.
- Use the existing topographic features of a site to slow, store and infiltrate stormwater.
- Protect and incorporate natural drainage features and patterns into site design.

2. Design site to minimize impervious surfaces.

Site designers, planners, engineers, landscape architects and architects work together to assess and design the site to:

- Minimize impervious surfaces such as rooftops, road and parking lots. Eliminate as much impervious surface as possible that conveys stormwater directly to streams or other surface waters. Vegetated roofs can replace asphalt rooftops. Pervious pavement can replace impervious pavement.
- Locate homes, other buildings, roads and parking away from critical areas and soils that infiltrate well.

3. Manage stormwater close to where the rain falls.

- Use small-scale, integrated management practices such as bioretention, permeable pavement and vegetated roofs—rather than one large pond.
- Create a landscape that slows storm flows and increases the amount of time storm flows stay on the site. LID tries to mimic the slow movement of water typical in a forested landscape.
- Increase reliability of the stormwater management system by providing multiple, redundant facilities. This reduces the likelihood of system failure.
- Integrate stormwater facilities into a site design to create a landscape that's attractive and also protects the environment. For example, a bioretention area can be a lush garden that beautifies the neighborhood AND manages stormwater.
- Reduce reliance on and use of traditional storm sewers, pipes and ponds.

4. Provide maintenance and education.

- Develop reliable and long-term maintenance programs with clear and enforceable guidelines.
- Educate homeowners, building owners and landscapers on the proper maintenance requirements for LID facilities.
- Involve neighborhoods in caring for their systems and in protecting their streams, wetlands and bays.

LID facts

- ▶ From 2000-2003, bioretention at the Seattle Street Edge Alternatives—SEA Streets project—prevented all dry season runoff and 99% of wet season runoff. Performance has improved since installation, resulting in no runoff from the project since December of 2002—even during heavy rains in the fall of 2003.



Bioretention swales at SEA Streets in Seattle are attractive and help protect nearby salmon streams by reducing stormwater volume by 99%.
| Seattle Public Utilities, City of Seattle.

- ▶ A variety of permeable paving surfaces at a King County office building infiltrated nearly 100% of stormwater runoff during a 6-year monitoring period. While 97% of the samples from an adjacent conventional asphalt parking lot exceeded toxic levels for copper and zinc, those metals couldn't even be detected in the majority of samples from the permeable paving surfaces.
- ▶ Seattle Public Utilities estimates that by using LID techniques, costs can be reduced 24 to 45% in street redesign projects. The Broadview Green Grid produced even greater cost savings. (Cost comparison is based on systems that provide comparable stormwater management.)
- ▶ The City of Bellingham estimates it reduced costs by 75 to 80% by constructing bioretention rather than in-ground vault systems in two parking areas.
- ▶ A green roof in Portland retained 69% of total rainfall during a 15-month monitoring period. Green roofs in Europe have consistently reduced stormwater runoff up to 50%.
- ▶ Bioretention at the University of Maryland removed 87 to 97% of total copper, lead and zinc as well as 73% of phosphorous.

LID—Coming soon to a neighborhood near you

The LID approach works almost anywhere—at the start of a new construction project or to reduce runoff from an existing property. LID works for individual homes, multi-home subdivisions, commercial businesses and industrial sites. LID works in a downtown urban center, in the suburbs, or in the country. Specific techniques will vary, depending on individual site conditions.

Many local governments in the Puget Sound region are finding LID so promising they are revising regulations to spur use of LID. The Puget Sound Action Team has offered its expertise in several ways to help the process.

Help for cities and counties

In 2005 and 2006, the Action Team created an innovative program that provided technical assistance to 12 cities and seven counties interested in integrating LID into their regulations. Summaries of the LID “Local Regulation Assistance Project” are at www.psat.wa.gov/lidassistance.

Manual provides technical guidance

To provide building professionals with a technical resource on LID practices, the Puget Sound Action Team and Washington State University Extension Pierce County developed the *Low Impact Development Technical Guidance Manual for Puget Sound*. The manual is the first in the region to offer technical guidance on LID.

The goal of the manual is to provide a common understanding of:

- Puget Sound hydrology and the effects of urban development.
- LID goals and objectives.
- Site assessment, site planning and layout.



Numerous residential LID practices, such as those illustrated above, improve stormwater management and provide wildlife habitat while making a more attractive, natural landscape. | *AHBL, Inc. Planners*

- Vegetation protection and revegetation.
- Detailed specifications for LID integrated management practices.
- Credits for reducing conventional stormwater facilities.
- National and international research findings and monitoring data.

To view or download a copy of the LID manual, visit the Action Team's Web site on LID at www.psat.wa.gov/LID.

Common LID practices

Preserving-clustering-dispersing. Protecting or replanting a significant portion of a development site's vegetation; locating development on a smaller part of the site; and directing runoff to vegetated areas. In many cases, the most efficient and cost-effective way to manage stormwater.

Bioretention (rain gardens). Shallow, landscaped areas composed of soil and a variety of plants. Bioretention cells are stand-alone features while bioretention swales are part of a conveyance system.



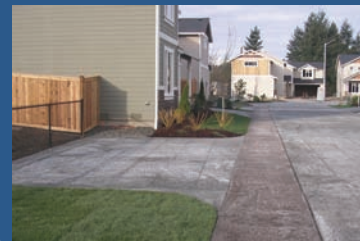
Bioretention—or rain gardens—not only look attractive, they also treat pollutants. | *Bruce Wulkan*

Soil amendments.

Compost added to soils disturbed during the construction process. Restores soil's health and its ability to infiltrate water.

Pervious pavement. Allows water to infiltrate and removes pollutants. Includes concrete, asphalt, pavers and grid systems filled with grass or gravel.

Vegetated roofs. Roofs composed of a waterproof layer, root barrier, drainage layer, growth media and plants. Provides slower release of runoff, improves energy efficiency, extends roof life and provides wildlife habitat and recreational amenities.



This residential subdivision in Sultan uses pervious concrete for streets and driveways, which reduces stormwater runoff by allowing water to seep through the ground. | *Craig Young*

Rooftop rainwater collection. Catchment systems or cisterns that collect rooftop runoff for irrigation, drinking water, grey water or other purposes. Reduces runoff and demand on groundwater supplies.

Minimal excavation foundations. Alternative building foundations composed of driven piles and a connector at or above grade. Eliminates the need for extensive excavation and reduces soil compaction.